DETAILED ACTION

Response to Arguments

1. Applicant's arguments, see page 2, filed on 01/23/2009, with respect to the 35 U.S.C. 112, second paragraph, rejection(s) of claim(s) 1-9, 11, 12, and 23-27 have been fully considered and are persuasive. Therefore the previous rejection has been withdrawn.

2. Applicant's argument regarding rejection of claim 13 has been fully considered but it is not persuasive. In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., the plural sets of transmitting symbol vectors are computed as shown on page 26 of the specification, where V is multiplied by a selection vector C1 and C0.) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 13 is rejected under 35 U.S.C. 102(e) as being anticipated by Ketchum et al. (hereafter, referred as Ketchum) (US 2003/0185310)

As to claim 13, Ketchum discloses a receiving apparatus (see e.g. Fig. 3, 350) for receiving data from a transmitting apparatus 310, the receiving apparatus comprising: an antenna (e.g. 354a) for transmitting a carrier modulation signal including a known symbol (see paragraphs 0072 and 0080, wherein Ketchum discloses that transmitter can estimate channel response based on the pilot transmitted by the receiver system on the uplink) and for receiving a signal from the transmitting apparatus; a propagation parameter estimation means (see Fig. 5, block 512) for estimating a propagation parameter from the received signal to generate receiving symbols (see the output of the decoder 536), the received signal being a signal including a transmitting symbol generated based on transmitting data and plural sets of transmitting symbols calculated from the known symbol in the transmitting apparatus (see paragraphs 0067 and 0069); and a symbol determination means for reconstructing the transmitting data from the receiving symbols (see Fig. 5, blocks 522, 532, 534, and 536).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 14-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ketchum, in view of Doberstein et al. (hereafter, referred as Doberstein) (US 6,424,678).

As to claim 14, Ketchum, discloses that the techniques described may be implemented in various wireless communication systems, including OFDM and CDMA systems, however, Ketchum does not expressly disclose a carrier separation means for separating the receiving signal, which is configured by multiple carriers, into a plurality of sub-carriers, wherein: the propagation parameter estimation estimates a propagation parameter for each of the sub-carriers and the symbol determination means reconstructs data from the received signal for each of the sub-carriers. Doberstein, in the same field of endeavor, discloses a receiver comprising a propagation parameter estimation means (see Fig. 6, block 618) for estimating a propagation parameter from a receiving signal (see column 8, lines 27-31); and a symbol determination means (see block 616) for reconstructing a transmitting data based on the propagation parameter. Doberstein further discloses a carrier separation means for separating the receiving signal, which is configured by multiple carriers, into a plurality of sub-carriers (see Fig. 6, blocks 610, 612, and 614), wherein: a propagation parameter estimation means estimates a propagation parameter for each of the sub-carriers (see block 618 and claim 5) and the symbol determination means (see block 616) reconstructs a transmitting data from the receiving signal for each of the sub-carriers. Since Ketchum discloses that his technique can be implemented in OFDM systems (i.e. a sub-carrier based system) (see paragraph 0191), it would have been obvious to one of ordinary

skill in the art at the time of invention to modify Ketchum as suggested by Doberstein to determine the effect of the communication channel for each of the data symbols and reconstruct the transmitted signals more accurately.

As to claim 15, Ketchum discloses that the sub-carriers are any one of an OFDM signal that is so configured as to be mutually-orthogonal in a frequency space and a CDMA signal that is so configured as to be mutually-orthogonal in a code space (see paragraph 0191).

As to claims 16 and 17, Ketchum further discloses an antenna element 354a (see Fig. 3), wherein said propagation parameter estimation means (see block 512) estimates the propagation parameter for that antenna.

As to claim 18, Ketchum discloses a receiving apparatus (see e.g. Fig. 3, 350) for receiving data from a transmitting apparatus 310, the receiving apparatus comprising: an antenna (e.g. 354a) for transmitting a carrier modulation signal including a known symbol (see paragraphs 0072 and 0080, wherein Ketchum discloses that transmitter can estimate channel response based on the pilot transmitted by the receiver system on the uplink) and for receiving a signal from the transmitting apparatus; a propagation parameter estimation means (see Fig. 5, block 512) for estimating a propagation parameter from the received signal to generate receiving symbol (see the output of the decoder 536), the received signal being a signal including a transmitting symbol generated based on transmitting data and plural sets of transmitting symbols calculated from the known symbol in the transmitting apparatus (see paragraphs 0067 and 0069); and a symbol determination means for reconstructing the transmitting data from the

receiving symbol (see Fig. 5, blocks 522, 532, 534, and 536) based on the channel estimation results. Ketchum does not expressly disclose that the propagation channel estimation means applies orthogonal detection to a received baseband signal. Ketchum also does not disclose that the received symbol is a complex symbol. Doberstein in the same field of endeavor, discloses a receiver comprising a propagation parameter estimation means (see Fig. 6, block 618) for estimating a propagation parameter from a receiving signal (see column 8, lines 27-31); and a symbol determination means (see block 616) for reconstructing a transmitting data based on the propagation parameter. Doberstein further discloses a propagation parameter estimation means (see block 616) for generating a receiving symbol that is a complex symbol by applying orthogonal detection (by using a quadrature down-converter) to a received baseband signal (see column 8, paragraphs 1-3). It would have been obvious to one of ordinary skill in the art at the time of invention to modify Ketchum as suggested by Doberstein to fully recover the baseband signal transmitted by the transmitter.

As to claim 19, Doberstein further shows a carrier separation means for separating the baseband signal (see Fig. 6), which is configured by a multiple carriers, into N pieces of sub-carrier elements, where N is an integer of 2 or more, wherein: the propagation parameter estimation means (see Fig. 6, block 618) generates the receiving symbol for each of the sub-carriers after the carrier separation means (see blocks 610, 612, and 614) separates the signal into the sub-carriers. Since Ketchum discloses that his technique can be implemented in OFDM systems (i.e. a sub-carrier based system) (see paragraph 0191), it would have been obvious to one of ordinary

skill in the art at the time of invention to modify Ketchum as suggested by Doberstein to determine the effect of the communication channel for each of the data symbols and more accurately reconstruct the transmitted signals.

5. Claims 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ketchum and Doberstein, further in view of Subramanian.

As to claim 20, Ketchum and Doberstein do not disclose that symbol determination means reconstruct transmitting data after the propagation parameter estimation means applies a reverse spread process to the baseband signal with N pieces of spread codes, wherein N is an integer of 2 or more. Subramanian discloses a communication system comprising a rake demodulator 108, wherein the rake demodulator has been configured to de-spread the received signals with different spreading codes (see Fig. 3 and column 5, lines 45-49). It would have been obvious to one of ordinary skill in the art at the time of invention to modify Ketchum and Doberstein, as suggested by Subramanian to take advantage of spread spectrum techniques in the communication system and recover the received signal accurately.

6. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ketchum and Doberstein, further in view of Bruekers et al. (hereafter, referred as Bruekers) (US 2002/0105907).

As to claim 21, Ketchum and Doberstein, disclose all the subject matters claimed in claim 19, except that symbol determination means determines a symbol based on the receiving power of the antenna. Bruekers discloses a communication system comprising a bit derivation circuit (interpreted as symbol determination) 17 that converts

the energy level of the bands (it has been interpreted as the received signal power at the antenna) into a binary value (see paragraph 0055). It would have been obvious to one of ordinary skill in the art at the time of invention to modify the symbol decision units disclosed by Ketchum and Doberstein as suggested by Bruekers to perform a robust verification of data (see paragraph 0006).

7. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ketchum, Doberstein, and Subramanian, further in view of Bruekers.

As to claim 22, Ketchum, Doberstein, and Subramanian disclose all the subject matters claimed in claim 20, except that symbol determination means determines a symbol based on the receiving power of the antenna. Bruekers discloses a communication system comprising a bit derivation circuit (interpreted as symbol determination) 17 that converts the energy level of the bands (it has been interpreted as the received signal power at the antenna) into a binary value (see paragraph 0055). It would have been obvious to one of ordinary skill in the art at the time of invention to modify the symbol decision units disclosed by Ketchum and Doberstein as suggested by Bruekers to perform a robust verification of data (see paragraph 0006).

8. Claims 1, 4, and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pautler et al. (hereafter, referred as Pautler) (US 2003/0185309), Belotserkovsky et al. (hereafter, referred as Belotserkovsky) (US 2003/0053571), and further in view of Huang et al. (hereafter, referred as Huang) (US 6,373,832).

As to claim 1, Pautler discloses a transmitting apparatus for transmitting data to a radio station (see Fig. 5), the apparatus comprising: an array antenna including M,

pieces of antenna elements (see antennas 102 and 140) for receiving a carrier modulation signal (see Fig, 3, modulation circuit) of a known symbol (i.e. the pilot signals, see paragraph 0070) that is transmitting from a radio station and for transmitting a signal to the radio station, where M is an integer of 2; a propagation channel estimation means (see block 128) for generating receiving symbols (see paragraphs 0010-0022) from a baseband signal received at the antenna elements (see paragraph 0066), wherein the receiving symbols are estimate values for a complex propagation channel between a transmitting antenna of the radio station and the array antenna (see paragraphs 0008-0009); a transmitting symbol (V) calculation means (see block 130) for calculating plural sets of transmitting symbol vectors (see paragraphs 0006, 0017,0091-0095) from the receiving symbols (H) so that each transmitting symbol vector is configured by plural sets of transmitting symbols (i.e. each element in each column of matrix V), a symbol mapping means (see paragraph 0071-0072) for generating transmitting symbols by selecting one set of the transmitting symbol vector based on transmitting data; and transmitting signals to the radio station through the array antenna (see antenna 140). Paulter does not expressly disclose saving a plurality of transmitting symbols in a reference table. However, it would have been extremely well known in the art at the time of invention to modify Paulter and save the results of transmitting symbol calculation for instance in a table for further processing. Paulter discloses all the subject matters claimed in claim 1, except for a reference symbol generation means for generating a reference symbol that gives a phase reference and is the same symbol with the known symbol for determining channel estimations; a

carrier modulation means for generating baseband signals from the transmitting symbols; and a transmitting means for converting baseband signals to radio frequency signals to transmit the radio frequency signals to the radio station through the array antenna. Belotserkovsky shows a communication system, comprising a channel estimator 50 (see Fig. 2). Belotserkovsky further shows a reference training symbol storage 58, which has been coupled to channel estimator 50 to provide the reference training symbol thereto. It would have been obvious to one of ordinary skill in the art at the time of invention to modify Pautler as suggested by Belotserkovsky to determine a more accurate channel estimate. Pautler and Belotserkovsky disclose all the subject matters claimed in claim 1, except for a carrier modulation means for generating baseband signals from the transmitting symbols; and a transmitting means for converting baseband signals to radio frequency signals to transmit the radio frequency signals to the radio station through the array antenna. Huang, in the same field of endeavor, discloses a CDMA transceiver system comprising a feedback path 34 (see Fig. 1A and the abstract). Huang further discloses that before sending any information (i.e. the transmitting symbols) to the transmitter through the feedback path, this information needs to be modulated (see modulator 37). Huang does not expressly discloses that the output of modulator 37 has been up-converted to radio frequency from baseband, however, it is extremely well known in the art that the system needs to convert the baseband signals to RF to facilitate data transmission over radio communication channels. Huang also does not expressly disclose that modulation is carrier (i.e. single carrier) modulation, however Huang's system is a CDMA

communication system and CDMA is an example of single carrier modulation technique. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to perform single carrier modulation in the system disclosed by Huang to transfer the signal according to CDMA standard. It would have been obvious to one of ordinary skill in the art at the time of invention to modify Pautler and Belotserkovsky as suggested by Huang to facilitate data transmission in the feedback channel.

As to claim 4, none of the references above expressly disclose that antenna elements configuring said array antenna have a mutually different directional pattern or mutually different polarization. However, setting the directional pattern of the antenna is a matter of design choice and it would have been obvious to one of ordinary skill in the art at the time of invention to modify Pautler, Belotserkovsky, and Huang to use antennas with different directional patterns to meet the design requirements of the system.

As to claim 7, Pautler discloses a transmitting symbol calculation means (see Fig. 5, block 130) calculates the plural sets of transmitting symbol vectors from the M pieces of receiving symbols so that the each transmitting symbol vector is configured by M pieces of transmitting symbols (see paragraphs 0006, 0017-0021), the symbol mapping means generates M pieces of transmitting symbols by selecting one set of transmitting symbol vector based on transmitting data (see paragraphs 0071-0072). Pautler and Belotserkovsky disclose all the subject matters claimed in claim 1, except for a carrier modulation means for generating baseband signals from the transmitting symbols. Huang, in the same field of endeavor, discloses a CDMA transceiver system

comprising a feedback path 34 (see Fig. 1A and the abstract). Huang further discloses that before sending any information (i.e. the transmitting symbols) to the transmitter through the feedback path, this information needs to be modulated (see modulator 37). Huang does not expressly disclose that modulation is carrier (i.e. single carrier) modulation, however Huang's system is a CDMA communication system and CDMA is an example of single carrier modulation technique Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to perform carrier modulation on the signals received from M antennas to transfer the signal according to the CDMA standard.

9. Claims 3 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pautler, Belotserkovsky, and Huang, further in view of Wallace et al. (hereafter, referred as Wallace) (US 2002/0193146).

As to claim 3, Pautler, Belotserkovsky, and Huang disclose all the subject matters claimed in claim 1, except that the transceiver applies a reverse spread separation process to the baseband signal received at the M pieces of antenna elements with N pieces of spread codes, and generates "M x N" pieces of receiving symbols. Wallace discloses a wireless communication system (see Fig. 10 A), wherein plurality of antennas at the transmitter (see antennas 208 and 210) transmit signal to an antenna array at the receiver (see antennas 214 and 216). Wallace further shows (see Fig. 10B) that at the receiver, a plurality of mixers apply a reverse spread separation process to the baseband signal received at the M pieces of antenna elements with N pieces of spread codes, and generate "M x N" pieces of receiving symbols. It would

have been obvious to one of ordinary skill in the art at the time of invention to modify Pautler to use different spreading codes for each antenna to maintain the orthogonality between the received symbols and reduce the interference on the received signal.

As to claim 6, none of the references above expressly disclose that antenna elements configuring said array antenna have a mutually different directional pattern or mutually different polarization. However, setting the directional pattern of the antenna is a matter of design choice and it would have been obvious to one of ordinary skill in the art at the time of invention to modify Pautler, Belotserkovsky, Huang, and Wallace to use antennas with different directional patterns to meet the design requirements of the system.

Allowable Subject Matter

10. Claims 23-27 allowed.

11. Claims 2, 5, 8, 9, 11, and 12 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Leila Malek whose telephone number is 571-272-8731. The examiner can normally be reached on 9AM-5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mohammad Ghayour can be reached on 571-272-3021. The fax phone

number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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